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SID 62-99-32

MONTHLY WEIGHT AND BALANCE REPORT
FOR THE APOLLO SPACECRAFT
CONTRACT NAS 9-150
(U)
PARAGRAPH 8.10, EXHIBIT I
1 OCTOBER 1964



SID-62-99-32

Prepared by

WEIGHT CONTROL

(NASA-CR-116646) MONTHLY WEIGHT AND BALANCE
REPORT FOR THE APOLLO SPACECRAFT, OCTOBER
1964 (North American Aviation, Inc.) 50 p

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~~CONFIDENTIAL~~INTRODUCTION

The October report continues to reflect the current Block II LOR spacecraft. The current weight status summarizes the changes from the previous Block II status in addition to the changes from the previous Block I status.

The current status reflects an unballasted Command Module L/D at entry of .30 for Block I and .38 for Block II. The current report reflects a Block II LOR spacecraft increase of 85 pounds at injection and 40 pounds at the injected spacecraft condition less Service Module propellant. The current injected weight of 90570 pounds is based on a Service Module propellant loading for a specific impulse of 313.0 seconds and a ΔV budget of the MSC Letter, PE5-64-78, dated approximately 11 February 1964, subject Contract NAS 9-150, Velocity Budget, Target Weight and Mission Plans. This is based on a lunar excursion module of 29,500 pounds, excluding crew, for Block II.

The current Block I status reflects a standard manned vehicle based on a 10.6 day mission. The major changes in the Block I are:

Command Module - Increases in flight qualification tape recorder and antenna transmission cabling, reduction in SCS equipment, deletion of bacteria control unit and reduction in electrical connectors.

Service Module - Increase in RCS temperature control system, addition of fuel cell temperature sustainer, addition of HF orbital antenna, increases in ECS common supports, reduction in electrical connector and pyrotechnic devices.

Launch Escape System - Increase in ballast consistent with Command Module and LES burnout balance requirement.

The current Block II status reflects a 10.6 day LOR mission. The major changes in the Block II are:

Command Module - Increase in window thickness, addition of communication installation for PISS's, decrease in lithium hydroxide, deletion of bacteria control unit and reduction in electrical connectors.

Service Module - Increase SPS engine due to non-incorporation of electrically operated ball valves, addition of fuel cell temperature sustainer, increase in reflectors and insulation based on Service Module boost heating, reduction in electrical connectors and pyrotechnic devices.

Launch Escape System - Decrease in ballast consistent with Command Module and LES burnout balance requirement.

The Earth Orbit Mission Weight Summary reflects the Saturn IB booster with a payload capability in orbit of 33,500 pounds. The payload capability has been reduced by 190 pounds to 33,310 pounds, due to the effective weight penalty of the Launch Escape System, as defined in MSFC Memorandum of 6600 12 June 1964 - Subject: Recommended Saturn IB Launch Vehicle Control Weights. The Service Module is loaded with 9340 pounds of propellant.

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BLOCK II

APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

1 OCTOBER STATUS

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT.2)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10060	1043.3	-0.1	6.3	4768	4207	3899
SERVICE MODULE - Less Propellant	10120	913.6	-4.7	7.9	7050	11211	11126
TOTAL - Less Propellant	20180	978.3	-2.4	7.1	11844	33739	33366
PROPELLANT - S/M**	37190	900.5	3.0	-1.3	19335	17595	24164
TOTAL - With Propellant	57370	927.9	1.1	1.7	31461	68605	74685
LUNAR EXCURSION MODULE	29500	588.5	0.0	0.0	19409	21485	21219
ADAPTER - LEM - S-IV B	3700	667.0	0.0	0.0	9255	12818	12818
TOTAL - Injected	90570	806.7	0.7	1.0	60142	603415	609222
LAUNCH ESCAPE SYSTEM	7940	1297.3	0.0	-0.1	550	19587	19604
TOTAL - SPACECRAFT LAUNCH	98510	846.2	0.6	1.0	60695	1002614	1008436

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the Command Module substructure mold line.

**The propellant weight of 37190 pounds is determined from an estimated time line analysis. The propellant weight is based on a specific impulse of 313.0, and includes 210 pounds of loading tolerance allowance.

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BLOCK II

APOLLO EARTH ORBIT MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

1 OCTOBER STATUS

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT ²)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10060	1043.3	-0.1	6.3	4761	4207	3899
SERVICE MODULE - Less Propellant	10120	913.6	-4.7	7.9	7050	11211	11126
TOTAL - Less Propellant	20180	978.3	-2.4	7.1	11844	33739	33366
PROPELLANT - S/M**	9430	871.5	27.3	-11.5	3140	2255	2717
TOTAL - With Propellant	29610	944.3	7.1	1.2	16688	52283	53117
ADAPTER - S-IV B	3700	667.0	0.0	0.0	9255	12818	12818
TOTAL - Injected	33310	913.5	6.3	1.0	25979	119674	120542
LAUNCH ESCAPE SYSTEM	7940	1297.5	0.0	-0.1	550	19587	19604
TOTAL - Spacecraft Launch	41250	987.3	5.1	0.8	26585	343158	344096

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal has an origin 1000 inches below the tangency point of the Command Module substructure mold line.

**The earth orbital weights are based on a complete Service Module and includes 9430 pounds of propellant. The propellant loading allocation is based on a payload in orbit of 33500 pounds. The payload capability has been reduced by 190 pounds to include the effective weight penalty due to the Launch Escape System increase from 6600 pounds to 7940 pounds.

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APOLLO LAUNCH ABORT CONFIGURATION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

1 OCTOBER STATUS

ITEM	WEIGHT	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT ²)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10060	1043.3	-0.1	6.3	4768	4207	3899
LAUNCH ESCAPE SYSTEM	7940	1297.3	0.0	-0.1	550	19587	19604
TOTAL - Launch Abort	18000	1155.3	-0.1	3.5	5357	85628	85298
LESS - MAIN AND PITCH MOTOR PROPELLANTS	-3190	1296.2	0.0	0.0	-69	-1288	-1288
TOTAL - LES Burnout	14810	1125.0	-0.1	4.2	5278	67726	67406

NOTE: * Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the Command Module substructure mold line.

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BLOCK II

COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LUNAR ORBIT RENDEZVOUS MISSION

1 OCTOBER STATUS

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT. 2)					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10060	1043.3	-0.1	6.3	4768	4207	3899	-8	-213	-46
Less: Boost & Mission Water	-8	1022.6	-63.4	-16.4						
Food	-48	1050.3	22.5	37.0						
Docking	-150	1110.0	0.0	0.0						
Add: Waste-Fecal	15	1039.0	47.0	12.0						
CO2 Absorbed	36	1016.3	-4.8	27.6						
Potable Water	30	1022.6	-63.4	-16.4						
Waste Water	56	1022.5	-21.1	+61.8						
PRIOR TO ENTRY	9991	1042.0	-0.4	6.6	4827	4101	3791	1	-217	-60
Less: Propellant	-135	1022.6	-5.1	56.6						
Ablator Burnoff	-365	1016.2	-0.4	15.7						
Entry Coolant	-6	1022.6	-63.4	-16.4						
Forward Heat Shield	-300	1090.0	0.0	1.0						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9135	1041.5	-0.3	5.8	4395	3537	3299	-5	-140	-55
Less: Main Chutes (3)	-419	1091.7	-0.3	7.7						
Propellant	-135	1022.6	-5.1	56.6						
LANDING	8581	1039.3	-0.2	5.0	4245	3196	2989	-8	-124	-48

NOTE: Mass inertia data is shown for accumulative totals only.

BLOCK II

COMMAND MODULE

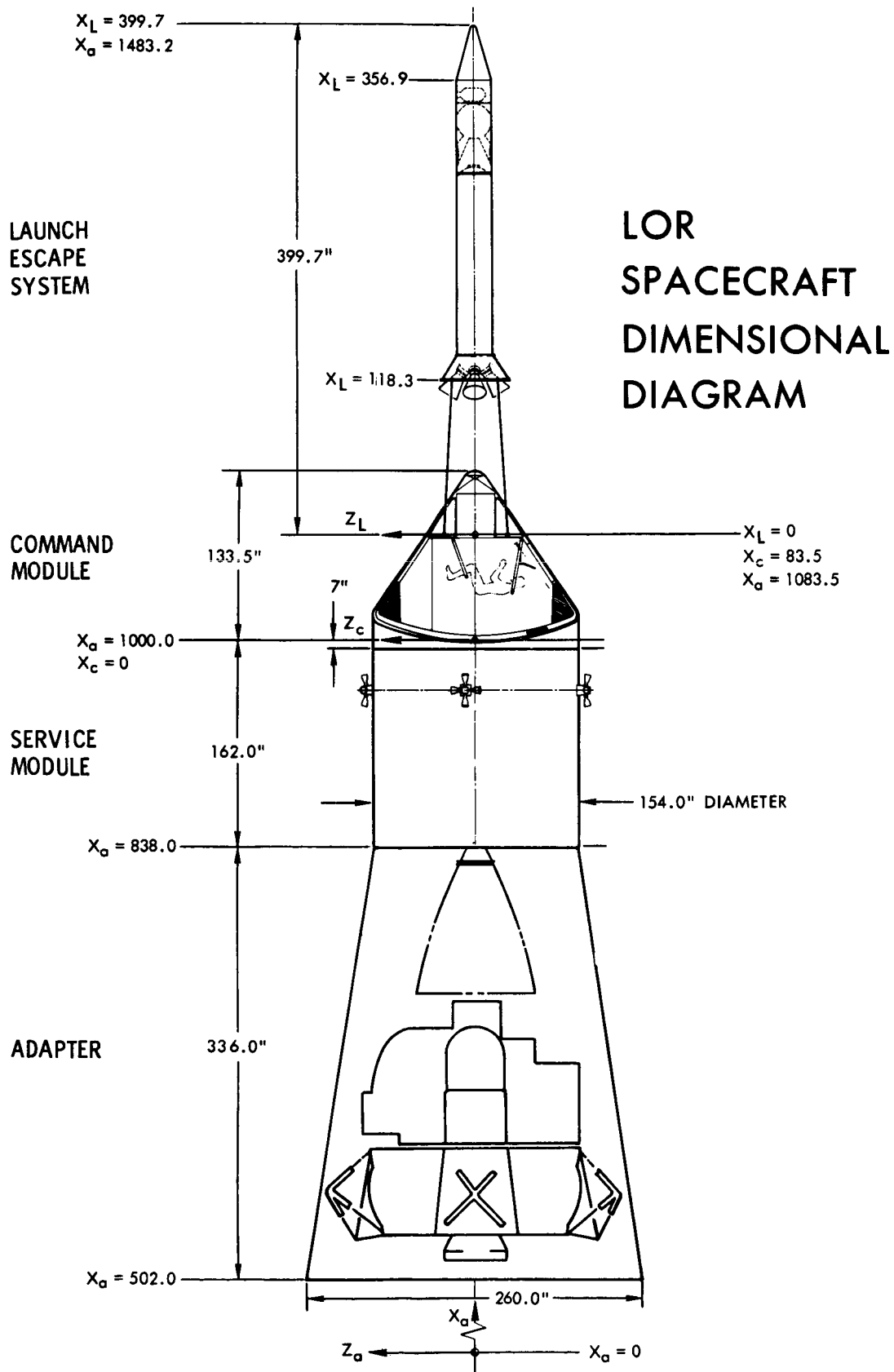
WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LOW ALTITUDE ABORT CONDITION

1 OCTOBER STATUS

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT. ²)					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10060	1043.3	-0.1	6.3	4768	4207	3899	-8	-213	-46
Less: Oxidant	-180	1022.6	15.6	62.4						
Forward Heat Shield	-300	1090.0	0.0	1.0						
Docking Provisions	-150	1110.0	0.0	0.0						
Drogue Chute	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9380	1040.9	-0.4	5.6	4555	3697	3508	3	-128	-79
Less: Main Chutes (3)	-419	1091.7	-0.3	7.7						
Fuel	-90	1022.6	-46.5	44.9						
LANDING	8871	1038.7	0.1	5.2	4436	3401	3178	-12	-126	-45

NOTE: Mass inertia data is shown for accumulative totals only.



NOTE: This page is to be revised consistent with the Block II Configuration.

~~CONFIDENTIAL~~BLOCK ISPACECRAFTWEIGHT STATUS SUMMARY

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK I STATUS		
				%EST	%CAL	%ACT
COMMAND MODULE	10560	+10	10570	31	67	2
SERVICE MODULE	9880	+70	9950	8	81	11
LAUNCH ESCAPE SYSTEM	8055	+5	8060	25	68	7
ADAPTER	3750		3750	27	73	
TOTAL WEIGHT LAUNCH - LESS SPS PROPELLANT	32245	+85	32330	22	72	6

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~~CONFIDENTIAL~~BLOCK IISPACECRAFTWEIGHT STATUS SUMMARY(LESS LEM)

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK II STATUS		
				%EST	%CAL	%ACT
COMMAND MODULE	10090	-30	10060	61	39	
SERVICE MODULE	10050	+70	10120	27	68	5
LAUNCH ESCAPE SYSTEM	7945	-5	7940	24	68	8
ADAPTER	3700		3700	26	74	
TOTAL LESS PROPELLANT	31785	+35	31820	37	60	3
PROPELLANT	37145	+45	37190		100	
GROSS WEIGHT	68930	+80	69010	17	82	1

INJECTED SPACECRAFTWEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64
COMMAND MODULE	10090	-30	10060
SERVICE MODULE	10050	+70	10120
ADAPTER	3700		3700
LEM	29500		29500
TOTAL S/C INJECTED LESS PROPELLANT	53340	+40	53380
PROPELLANT	37145	+45	37190
TOTAL INJECTED WEIGHT	90485	+85	90570

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~~CONFIDENTIAL~~BLOCK ICOMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK I STATUS		
				%EST	%CAL	%ACT
<u>WEIGHT EMPTY</u>	(9335)	(+17)	(9352)	(31)	(67)	(2)
Structure	5008		5008	11	86	3
Stabilization & Control	269	-21	248	17	83	
Guidance & Navigation	395	-3	392	45	55	
Crew Systems	471		471	75	25	
Environmental Control	313		313	35	57	8
Earth Landing System	650		650	81	19	
Instrumentation	544	+31	575	64	36	
Electrical Power	611	-3	608	83	17	
Reaction Control	358	+1	359	58	42	
Communication	370	+10	380	3	97	
Controls & Displays	346	+2	348	22	78	
<u>USEFUL LOAD</u>	(1225)	(-7)	(1218)	(28)	(72)	
Scientific Equipment	-	-	-			
Crew Systems	825		825	41	59	
Reaction Control	270		270		100	
Environmental Control	130	-7	123		100	
GROSS WEIGHT	10560	+10	10570	31	67	2

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~~CONFIDENTIAL~~BLOCK IICOMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK II STATUS		
				%EST	%CAL	%ACT
<u>WEIGHT EMPTY</u>	(8549)	(+97)	(8646)	(65)	(35)	
Structure	4608	+75	4683	54	46	
Stabilization & Control	207	+5	212	100		
Guidance & Navigation	365	+13	378	100		
Crew Systems	391	+4	395	78	22	
Environmental Control	357	-16	341	60	40	
Earth Landing System	736		736	83	17	
Instrumentation	252	-1	251	100		
Electrical Power	641	-16	625	85	15	
Reaction Control	329	+10	339	70	30	
Communication	299	+14	313	80	20	
Controls & Displays	364	+9	373	40	60	
<u>USEFUL LOAD</u>	(1421)	(-7)	(1414)	(30)	(70)	
Scientific Equipment	80		80		100	
Crew Systems	941	+9	950	45	55	
Reaction Control	270		270		100	
Environmental Control	130	-16	114		100	
<u>CONTINGENCY</u>	(120)	(-120)	(-)	(-)	(-)	
Contingency	120	-120	-			
GROSS WEIGHT	10090	-30	10060	61	39	

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COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>STRUCTURE</u>	(-)	(+75.0)
Decrease main display panel due to integrating the various subpanels originally provided to allow design flexibility.	-	-4.0
Add lower equipment bay supports required for food compartments which were previously provided by crew systems.	-	+8.0
Increase crew compartment heat shield based on current design not allowing for window thickness reduction.	-	+11.0
Add weight reduction contingency previously not distributed to the various systems	-	+60.0
<u>STABILIZATION AND CONTROL</u>	(-21.0)	(+5.0)
Decrease SCS equipment based on Honeywell status reflecting revised estimates for humidity and EMI fixes .	-21.0	-
Add weight reduction contingency previously not distributed to the various systems.	-	+5.0
<u>GUIDANCE AND NAVIGATION</u>	(-3.0)	(+13.0)
Increase optical equipment due to recoding optics cover and optical shroud from Controls and Displays based on MIT status report.	+4.7	+4.7
Decrease G & N equipment based on MIT status reflecting current weight of the Block I-F system.	-7.7	-
Increase rendezvous radar provisions based on revised estimate of umbilical relocation change..	-	+2.3
Add weight reduction contingency previously not distributed to the various systems.	-	+6.0

COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>CREW SYSTEMS</u>	(-)	(+4.0)
Add work and food preparation shelf and stowage drawer assembly per current requirements.	-	+3.0
Add weight reduction contingency previously not distributed to the various systems.	-	+1.0
<u>ENVIRONMENTAL CONTROL</u>	(-)	(-16.0)
Increase water-glycol circuit plumbing and hardware based on current drawing calculations.	+3.2	+3.2
Delete added pump required for Service Module freon heat transfer system as this system has been deleted.	-	-10.5
Decrease waste management system based on deleting the bacteria control unit per current system requirements.	-3.2	-3.2
Decrease postlanding ventilation system based on deleting water pump and hoses per current system requirements.	-	-4.0
Delete Service Module heat transfer system wiring as the Block II vehicle does not employ a temperature control system.	-	-3.5
Add weight reduction contingency previously not distributed to the various systems.	-	+2.0
<u>INSTRUMENTATION</u>	(+31.0)	(-1.0)
Increase viewfinder stowage container based on revised estimate.	+1.0	+1.0
Increase flight qualification tape recorder based on current procurement specification requirement.	+30.0	-

COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>INSTRUMENTATION (Cont'd.)</u>		
Decrease wiring based on current estimate of relocated umbilical and weight reductions.	-	-19.0
Increase PCM unit based on current vendor estimate.	-	+2.0
Add weight reduction contingency previously not distributed to the various systems.	-	+15.0
<u>ELECTRICAL POWER</u>	(-3.0)	(-16.0)
Increase power conversion inverters based on current Westinghouse status report reflecting EMI fixes.	+5.7	+5.7
Increase wiring based on revised estimate of umbilical relocation and wire weight reduction.	-	+13.0
Decrease phase correcting capacitor based on current drawing calculation.	-2.0	-2.0
Increase terminal distribution panels based on current drawing calculation.	+1.3	+1.3
Decrease umbilical disconnect based on revised estimate of umbilical relocation.	-	-27.0
Decrease electrical transmission connector based on current estimates.	-18.0	-28.0
Increase interior floodlights due to replacing with larger units employing standard filament lamps.	+3.4	+3.4
Increase RCS sequencer based on current drawing calculation.	+2.8	+2.8
Increase installation provisions based on current drawing calculation.	+3.8	+3.8
Add weight reduction contingency previously not distributed to the various systems.	-	+11.0

COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>REACTION CONTROL</u>	(+1.0)	(+10.0)
Increase engines based on current Rocketdyne status reflecting vibration requirements.	+1.0	+1.0
Increase wiring based on revised estimate of umbilical relocation change and wire reductions.	-	+8.0
Add weight reduction contingency previously not distributed to the various systems.	-	+1.0
<u>COMMUNICATIONS</u>	(+10.0)	(+14.0)
Decrease the VHF AM and FM transmitter equipment based on Collins report reflecting actual in lieu of calculated weights.	-0.6	-
Increase the central timing equipment based on latest Elgin information reflecting a revised estimate.	+2.0	-
Decrease recovery antenna based on revised estimate of changes to CCA 201.	-5.0	-6.7
Increase transmission lines for the C-Band antenna based on revised estimates utilizing cables capable of withstanding higher temperatures.	+5.8	-
Increase transmission lines for the VHF-2KMC Omni Antenna based on revised estimates utilizing cables capable of withstanding higher temperatures.	+6.1	-
Increase communication equipment based on revised estimates for the Block II equipment repackaging.	-	+10.5
Add a multiplexer required to perform CSM/EYA duplex voice communication and EVA/CSM/GOSS and LEM/CSM/GOSS voice conference capability.	-	+4.5
Increase the 2KMC Omni Antenna Switch based on revised estimate.	-	+0.2

COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>COMMUNICATIONS (Cont'd.)</u>		
Decrease VHF Omni Antenna transmission lines based on revised estimates of cabling lengths.	-	-8.0
Add a latching relay required to convert the Up-Data Link pulse signal to a D.C. voltage suitable for energizing the abort request light.	+1.7	-
Increase high gain antenna wiring and coax based on revised estimate of umbilical change.	-	+2.5
Add weight reduction contingency previously not distributed to the various systems.	-	+11.0
<u>CONTROLS AND DISPLAYS</u>	(+2.0)	(+9.0)
Increase main display panel equipment based on miscellaneous drawing calculations.	+0.7	+0.2
Increase G & N computer keyboards based on current MIT report.	+2.0	-
Increase G & N map and data viewer based on current MIT report.	+0.3	-
Increase G & N Navigator Display based on current MIT report.	+0.3	+0.5
Decrease G & N Navigator Display based on recoding optical equipment to Guidance and Navigation consistent with current MIT report.	-4.7	-4.7
Decrease G & N Block II computer keyboard based on current MIT report.	-	-6.4
Increase caution and warning detector based on current Autonetic status.	+1.5	-
Add an SCS hand control cable junction box based on current drawing release.	+1.9	+1.9

COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>CONTROLS AND DISPLAYS (Cont'd.)</u>		
Add an up-data link display to provide direct readout of information transmitted by GOSS per NASA direction.	-	+10.0
Increase wiring provisions based on revised estimate of weight reduction.	-	+2.0
Decrease angle of attack display based on current estimates.	-	-0.5
Add weight reduction contingency previously not distributed to the various systems.	-	+6.0
TOTAL COMMAND MODULE CURRENT WEIGHT EMPTY CHANGES	+17.0	+97.0

COMMAND MODULECURRENT USEFUL LOAD CHANGES

	BLOCK I	BLOCK II
<u>CREW SYSTEMS</u>	(-)	(+9.0)
Add two PLSS mounted communication, electrical monitoring and telemetry per NASA direction (GFE).	-	+9.6
Delete one water cooled constant wear garment per NASA direction (GFE).	-	-2.0
Decrease supports based on revised estimate.	-	-0.6
Add weight reduction contingency previously not distributed to the various systems.	-	+2.0
<u>ENVIRONMENTAL CONTROL</u>	(-7.0)	(-16.0)
Decrease lithium hydroxide and containers based on CO ₂ absorption and mission duration.	-3.2	-12.2
Delete chemical disinfectant based on deleting the bacteria control unit per current system requirements.	-3.8	-3.8
<hr/>		
TOTAL COMMAND MODULE CURRENT USEFUL LOAD CHANGES	-7.0	-7.0

COMMAND MODULECONTINGENCY

	BLOCK I	BLOCK II
<u>CONTINGENCY</u>	(-)	(-120.0)
Remove the weight reduction contingency entry due to distributing it to the various systems.	-	-120.0
<hr/>		
TOTAL This page	-	-120.0
TOTAL COMMAND MODULE CURRENT WEIGHT EMPTY CHANGES	+17.0	+97.0
TOTAL COMMAND MODULE CURRENT USEFUL LOAD CHANGES	-7.0	-7.0
<hr/>		
TOTAL COMMAND MODULE CURRENT WEIGHT CHANGES	+10.0	-30.0

~~CONFIDENTIAL~~BLOCK ISERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK I STATUS		
				%EST	%CAL	%ACT
<u>WEIGHT EMPTY</u>	(7761)	(+70)	(7831)	(10)	(76)	(14)
Structure	2339	+9	2348	8	77	15
Environmental Control	164	+53	217	12	87	1
Instrumentation	130		130	26	74	
Electrical Power	1448	-11	1437	15	34	51
Main Propulsion	3090		3090	5	95	
Reaction Control	589	+5	594	24	76	
Communication & Rendezvous Radar	1	+14	15	100		
<u>USEFUL LOAD</u>	(2119)		(2119)		(100)	
Reaction Control	838		838		100	
Electrical Power	503		503		100	
Environmental Control	208		208		100	
Main Propulsion	570		570		100	
TOTAL SERVICE MODULE BURNOUT	9880	+70	9950	8	81	11

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~~CONFIDENTIAL~~BLOCK IISERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK II STATUS		
				%EST	%CAL	%ACT
<u>WEIGHT EMPTY</u>	(7762)	(+140)	(7902)	(34)	(60)	(6)
Structure	2422	+29	2451	35	65	
Environmental Control	112	+6	118	20	80	
Instrumentation	151	-13	138	35	65	
Electrical Power	1430	-2	1428	30	34	36
Main Propulsion	2873	+42	2915	31	69	
Reaction Control	524	+80	604	30	70	
Communications & Rendezvous Radar	250	-2	248	100		
<u>USEFUL LOAD</u>	(2218)		(2218)		(100)	
Reaction Control	838		838		100	
Electrical Power	503		503		100	
Environmental Control	208		208		100	
Main Propulsion	669		669		100	
<u>CONTINGENCY</u>	(70)	(-70)	(-)			
TOTAL SERVICE MODULE BURNOUT	10050	+70	10120	27	68	5

~~CONFIDENTIAL~~

SERVICE MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>STRUCTURE</u>	(+9.0)	(+29.0)
Increase aft bulkhead due to adding bonded doubler to increase cross sectional area for Service Module to Adapter loads.	+9.0	+9.0
Add weight reduction contingency previously not distributed to the various systems.	-	+20.0
<u>ENVIRONMENTAL CONTROL</u>	(+53.0)	(+6.0)
Increase temperature control system based on calculation of current released drawings.	+44.8	-
Increase common items supports and hardware which had previously assumed to be included in the structure weight and were omitted.	+14.5	+14.5
Decrease water supply system plumbing based on calculation of released drawings.	-4.3	-4.3
Decrease oxygen system plumbing based on calculation of released drawings.	-2.0	-2.0
Delete miscellaneous hardware not required with the deletion of the TCS system.	-	-1.6
Decrease wiring consistent with revised estimate of weight reduction.	-	-0.6
<u>INSTRUMENTATION</u>	(-)	(-13.0)
Decrease electrical provisions based on revised estimate of umbilical relocation and wire weight reduction.	-	-18.0
Add weight reduction contingency previously not distributed to the various systems.	-	+5.0

SERVICE MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>ELECTRICAL POWER</u>	(-11.0)	(-2.0)
Increase oxygen tank support shelves based on the addition of stiffeners and recalculation of filler and bond.	+6.0	-
Increase fuel cell per current Pratt and Whitney status adding a temperature sustainer and control.	+12.3	+12.3
Increase fuel cell plumbing supports based on recalculation of drawing changes.	+ 1.8	+1.8
Increase fuel cell attachments based on recalculation of drawing changes.	+1.4	+1.4
Decrease electrical transmission connectors based on current estimates.	-19.8	-17.5
Decrease shape charge assembly based on current drawing calculations.	-2.7	-2.0
Increase shape charge due to additional requirement for the relocated umbilical.	-	+20.0
Decrease wiring based on revised estimate of umbilical relocation.	-	-16.0
Decrease pyrotechnic devices consistent with current drawing calculations.	-10.0	-10.0
Add weight reduction contingency previously not distributed to the various systems.	-	+8.0
<u>MAIN PROPULSION</u>	(-)	(+42.0)
Increase engine based on eliminating change to incorporate SPS electrically operated ball valves.	-	+10.0
Increase wiring based on a revised estimate of the umbilical change and wire weight reduction.	-	+3.0
Add weight reduction contingency previously not distributed to the various systems.	-	+29.0

SERVICE MODULECURRENT WEIGHT EMPTY CHANGES

	BLOCK I	BLOCK II
<u>REACTION CONTROL</u>	(+5.0)	(+80.0)
Increase engine per Marquardt status redesigning thrust chamers to eliminate shattering.	+5.0	+5.0
Increase reflectors and insulation based on Service Module boost heating and RCS plume impingment requiring cork installation and eliminating titanium facesheet saving.	-	+65.0
Increase wiring based on a revised estimate of the umbilical change and wire weight reduction.	-	+2.0
Add weight reduction contingency previously not distributed to the various systems.	-	+8.0
<u>COMMUNICATIONS AND RENDEZVOUS RADAR</u>	(+14.0)	(-2.0)
Add an antenna for orbital HF voice communication capability per CCA 201.	+14.0	-
Decrease VHF antenna and transmission lines per revised estimates.	-	-2.0
<hr/>		
TOTAL SERVICE MODULE CURRENT WEIGHT EMPTY CHANGES	+70.0	+140.0

SERVICE MODULECONTINGENCY

	BLOCK I	BLOCK II
<u>CONTINGENCY</u>	(-)	(-70.0)
Remove the weight reduction contingency entry due to distributing it to the various systems.	-	-70.0
<hr/>		
TOTAL This Page	-	-70.0
TOTAL SERVICE MODULE CURRENT WEIGHT EMPTY CHANGES	+70.0	+140.0
<hr/>		
TOTAL SERVICE MODULE CURRENT WEIGHT CHANGES	+70.0	+70.0

~~CONFIDENTIAL~~BLOCK ILAUNCH ESCAPE SYSTEMWEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK I STATUS		
				%EST	%CAL	%ACT
Structure	1484		1484	55	40	5
Electrical System	53		53	73	27	
Propulsion System						
Main Thrust	4774		4774		100	
Jettison	434		434			100
Jettison Motor Skirt	92		92			100
Pitch Control	49		49		100	
Separation Provisions	15		15	53	47	
C/M Boost Prot. Cover	520		520	100		
LES - NO BALLAST	7421		7421	19	73	8
BALLAST	634	+5	639	100		
TOTAL LAUNCH ESCAPE SYSTEM	8055	+5	8060	25	68	7

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~BLOCK IILAUNCH ESCAPE SYSTEMWEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK II STATUS		
				%EST	%CAL	%ACT
Structure	1484		1484	55	40	5
Electrical	53		53	73	27	
Propulsion System						
Main Thrust	4774		4774		100	
Jettison	434		434			100
Jettison Motor Skirt	92		92			100
Pitch Control	49		49		100	
Separation Provisions	15		15	53	47	
C/M Boost Prot. Cover	535		535	100		
LES - NO BALLAST	7436		7436	19	73	8
BALLAST	509	-5	504	100		
TOTAL LAUNCH ESCAPE SYSTEM	7945	-5	7940	24	68	8

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LAUNCH ESCAPE SYSTEM
CURRENT WEIGHT CHANGES

	BLOCK I	BLOCK II
<u>BALLAST</u>	(+5.0)	(-5.0)
Change ballast consistent with Command Module and LES balance requirements.	+5.0	-5.0
<hr/>		
TOTAL LAUNCH ESCAPE SYSTEM CURRENT WEIGHT CHANGES	+5.0	-5.0

~~CONFIDENTIAL~~BLOCK IADAPTER WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK I STATUS		
				%EST	%CAL	%ACT
Structure	3220		3220	17	83	
Electrical	70		70	82	18	
Separation System	360		360	90	10	
Propellant Dispersal System	100		100	100		
TOTAL ADAPTER	3750		3750	27	73	

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~BLOCK IIADAPTER WEIGHT STATUS

ITEM	PREVIOUS STATUS 9-1-64	CHANGES TO CURRENT	CURRENT STATUS 10-1-64	BASIS FOR CURRENT BLOCK II STATUS		
				%EST	%CAL	%ACT
Structure	3145		3145	15	85	
Electrical	70		70	82	18	
Separation System	360		360	90	10	
Propellant Dispersal System	125		125	100		
TOTAL ADAPTER	3700		3700	26	74	

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COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IISTRUCTURE

(-325.0)

Decrease ablator due to incorporating a boost protective cover to carry the boost and abort loads and allow the ablator to be designed for entry temperatures only, also add a thermal control coating which allows a reduction in temperature of the ablator prior to entry from +250 to 100F and allows a reduction of required ablator thickness.

-265.0

Decrease ablator based on reduced ablator thickness accomplished by changing the backface design temperature criteria of +600 F at impact to +600 F at parachute deployment for the aft heat shield ablator.

-50.0

Decrease ablator due to redesign incorporating a flat top forward heat shield that is cut back to station 104.5 and allows external mounting of the docking system which is protected by the Boost Protective Cover.

-20.0

Decrease forward heat shield due to redesign incorporating a flat top forward heat shield that is cut back to Station 104.5 and allows external mounting of the docking system.

-35.0

Increase side hatch cover due to adding provisions to operate the hatch cover latches from the outside and add an aluminum inner sheet which will compensate for thermal distortion experienced when it is opened in deep space.

+10.0

Decrease inner structure due to redesign utilizing a single-point "static gimbal" (flower-pot) chute riser attachment. This arrangement removes the concentrated chute loads from the longerons, and eliminates the main chute riser wrap-around loads from the bulkhead gussets and from the forward cylinder.

-79.0

Decrease the side access hatch and hatch cover due to deleting the window which will not be used for any Apollo lunar landing missions.

-25.0

Add supports for the post landing ventilation system.

+6.0

COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IISTRUCTURE (CONT'D)

Increase center section heat shield substructure due to the attachment of the relocated horizontally mounted forward pitch motors assembly.	+7.0
Decrease crew compartment heat shield substructure due to utilizing titanium in lieu of steel for the aft compartment (pork chop) frames.	-41.0
Decrease main display panel due to integrating the various subpanels originally provided to allow design flexibility.	-4.0
Decrease lower equipment bay structure and coldplates due to redesign incorporating full electronic repackaging and method of mounting equipment to the frames at X _C 42 and 20 thus reducing the number of vertical members required.	-45.0
Decrease forward heat shield due to removal of access door to pitch motor.	-5.0
Add lower equipment bay supports required for food compartments which were previously provided by Crew Systems.	+8.0
Add a docking system consisting of a probe and drogue mechanism required to transfer two crewman from CM vehicle to the LEM vehicle in lunar rendezvous.	+150.0
Increase secondary structure heat shield equipment area due to the relocation of the command module to service module umbilical.	+30.0
Delete secondary structure supports required for Block I R&D equipment	-27.0
Add weight reduction contingency	+60.0

COMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IISTABILIZATION & CONTROL

(-36.0)

Decrease equipment and wiring due to repackaging for the ring mounted lower equipment bay concept and incorporating redundant switching for eliminating inflight maintenance consistent with humidity and EMI proofing.

-33.0

Increase wiring consistent with the 1300 wire umbilical requirement.

+12.0

Decrease electrical wiring and connectors based on reduced wire gauges and utilizing small connectors.

-20.0

Add weight reduction contingency.

+5.0

GUIDANCE AND NAVIGATION

(-14.0)

Decrease equipment and wiring due to incorporating the Block II G & N system for the lunar spacecraft.

-28.0

Increase wiring consistent with preliminary requirements.

+9.0

Decrease electrical wiring and connector based on reduced wire gauges and utilizing small connectors.

-13.0

Add wiring provisions for the rendezvous radar equipment.

+14.0

Decrease wiring due to reducing requirement of the controls and displays computer keyboard.

-2.0

Add weight reduction contingency.

+6.0

CREW SYSTEMS

(-76.0)

Increase egress accessories due to adding aids for extra vehicular activities.

+10.0

Delete food storage box supports as this requirement has been integrated with secondary structure design.

-17.0

Decrease crew couch due to redesigning for a unitized configuration offering improved operational capability **though** compatible with the Block I attenuation system.

-70.0

Add weight reduction contingency.

+1.0

COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IIENVIRONMENTAL CONTROL

(+28.0)

Add a free condensate control required to minimize the amount of condensation in the cabin which if excessively accumulated would harmfully affect the respiration of the crew and cause degradation of electronic equipment.

+10.0

Provide the CO₂ absorber elements with a bypass in order to attain minimum oxygen flow of 10 CFM/Man in 3.5 psia (suited) condition.

+10.0

Add a LEM water transfer system.

+5.0

Increase AirResearch components consistent with current Block II requirements.

+3.0

Delete wiring provisions for Service Module temperature control system.

-4.0

Add provisions for a post landing ventilation system.

+4.0

Increase wiring **provisions consistent with preliminary requirements.**

+3.0

Decrease electrical wiring and connectors based on reduced gauges and utilizing small connectors.

-5.0

Add weight reduction contingency.

+2.0

EARTH LANDING SYSTEM

(+86.0)

Incorporate Block II configuration utilizing a single point parachute attachment and repackaging of chutes.

-4.0

Add a (3) bag flotation system.

+40.0

Redesign main parachute for higher descending weight.

+35.0

Add a sea pick-up hook to facilitate recovery.

+15.0

COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II

<u>INSTRUMENTATION</u>	(-324.0)
Delete R & D instrumentation required for flight qualification.	-322.0
Add Nuclear Radiation Detection provisions required for the lunar vehicle.	+0.7
Add wiring to provide connection between the caution and warning panel and the units previously tested with the in-flight test system.	+5.0
Add provisions to provide for S-IV B EDS interface.	+20.0
Add checkout provisions for the LEM in the stowed and docked position.	+28.0
Decrease PCM equipment due to repackaging for the ring mounted lower equipment concept.	-15.0
Add an in-flight test system panel.	+5.0
Increase wiring consistent with the present operational instrumentation requirements.	+49.0
Decrease electrical wiring and connectors based on reduced wire gauges and utilizing connectors.	-81.7
Decrease wiring based on relocating CM to SM umbilical.	-28.0
Add weight reduction contingency.	+15.0
<u>ELECTRICAL POWER</u>	(+17.0)
Add a DC-DC line voltage regulators to regulate the output at 28 ± 0.5 volts for postlanding loads.	+4.0
Increase entry-postlanding batteries based on current landing and postlanding loads.	+21.0
Increase electrical wiring and connectors consistent with the 1300 wire umbilical requirements	+33.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-39.0
Decrease wiring based on relocating CM to SM umbilical.	-13.0
Add weight reduction contingency.	+11.0

CONSTANT MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II

<u>REACTION CONTROL</u>	(-20.0)
Increase electrical wiring consistent with the present requirements.	+16.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-26.0
Decrease wiring based on relocated CM to SM umbilical	-11.0
Add weight reduction contingency.	+1.0
<u>COMMUNICATIONS</u>	(-67.0)
Delete C-Band antenna and utilize S-Band for low altitude tracking.	-17.5
Decrease equipment and wiring due to repackaging for the ring mounted lower equipment bay concept incorporating humidity and EMI proofing consistent with no inflight maintenance.	-52.1
Replace the scimitar antenna with the "S" band antenna.	+20.4
Transfer the VHF antenna to the Service Module.	-27.4
Increase electrical wiring based on revised estimates.	+9.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-14.0
Increase electrical provisions due to adding wiring required for the high gain antenna.	+10.4
Delete orbital HF voice communication capability.	-3.0
Delete VHF antenna erection mechanism as this function is built into the Block II system.	-1.8
Decrease high gain antenna wiring based on relocated umbilical.	-2.0
Add weight reduction contingency.	+11.0

COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IICONTROLS AND DISPLAYS

(+25.0)

Chem-etch mounting panels for the LOR vehicles that could not be accomplished due to schedule on Block I.	-4.0
Decrease lower equipment bay G & N controls and displays due to incorporating the Block II G & N system for the lunar spacecraft.	-9.2
Add rendezvous radar panel required for LOR mission.	+7.0
Add Nuclear Radiation Display.	+3.5
Add high gain antenna control required for deep space communication.	-4.5
Increase caution and warning detector	+6.5
Modify control and display for the lunar vehicle.	+24.5
Utilize a partial main display computer keyboard.	-9.0
Decrease main display panel due to eliminating subpanels and display by increasing time sharing of display.	-5.8
Add an angle of attack display.	+2.0
Increase electrical wiring consistent with the 1300 wire umbilical requirement.	+23.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-37.0
Add an up-data link display.	+13.0
Add weight reduction contingency	+6.0

TOTAL COMMAND MODULE ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II
(To be brought forward)

-706.0

COMMAND MODULECURRENT ESTIMATED USEFUL LOAD CHANGES TO BLOCK II

<u>SCIENTIFIC EQUIPMENT</u>	(+80.0)
Add scientific equipment based on current LOR mission requirements.	+80.0
<u>CREW SYSTEM</u>	(+125.0)
Add two portable life support systems based on the current requirements of the LOR vehicle and LEM	+120.9
Decrease hygiene and medical storage boxes based on redesign of containers that cannot be accomplished on early Block I vehicles.	-5.8
Utilize Apollo spacesuits in lieu of Gemini.	+10.6
Add spare glove, repair kit and ring seals for the Apollo spacesuit per NASA.	+3.7
Decrease survival kit based on NASA information reflecting (1) three men life raft in lieu of (3) one man life rafts and their associated equipment.	-8.5
Decrease food based on current NASA requirements.	-3.9
Add two charged water cooled constant wear garments per current NASA list.	+7.0
Add weight reduction contingency.	+1.0
<u>ENVIRONMENTAL CONTROL</u>	(-9.0)
Decrease lithium hydroxide based on lunar mission analysis.	-9.0
 TOTAL COMMAND MODULE ESTIMATED USEFUL LOAD CHANGES TO BLOCK II	 +196.0
 TOTAL COMMAND MODULE ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II	 -706.0
 TOTAL COMMAND MODULE ESTIMATED CHANGES TO BLOCK II	 -510.0

SERVICE MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II

<u>STRUCTURE</u>	(+103.0)
Add structural beef-up required to support the rendezvous radar equipment.	+35.0
Add structural provisions for supporting the high gain antenna required for deep space communication.	+30.0
Increase structural provisions for the C/M to S/M umbilical fairing due to enlarging the capacity to 1300 wires.	+9.0
Increase engine mount and backup structure due to stiffness requirements.	+50.0
Add micrometeoroid protection in outboard sectors of the four propellant tanks to afford the greatest reliability. The shielding will be of an internal type mounted directly to the outboard panels.	+110.0
Decrease structure due to reducing factor of safety from 1.5 to 1.4 on all structures requiring redesign.	-25.0
Decrease outer shell panel based on redesign to a semi-arched structure with a lesser end moment requirement and a change in the helium pressurization access door from structural to nonstructural.	-50.0
Decrease radial beams due to reduction in web gauges, stifferer cap area, and inner and outer cap areas.	-13.0
Decrease forward bulkhead due to redesigning to a spider truss structure in lieu of honeycomb panels.	-84.0
Decrease aft bulkhead due to a reduction of face sheet thickness, density of honeycomb core, and the outer ring.	-10.0
Add support shelves for relocated equipment from Sector I.	+50.0
Decrease insulation on aft bulkhead due to reduction in Q-felt density.	-9.0
Decrease outer shell panel due to an increase in radiator size required by philosophy change allowing selective freezing.	-10.0
Add weight reduction contingency.	+20.0

SERVICE MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II

<u>ENVIRONMENTAL CONTROL</u>	(-99.0)
Delete RCS temperature control system as this system is not utilized on the Block II vehicle.	-121.0
Increase radiator size based on philosophy change allowing selective freezing.	+22.0
<u>INSTRUMENTATION</u>	(+8.0)
Add radiation detection sensors to the Service Module.	+3.0
Add provisions for LEM monitoring in a stowed position.	+22.0
Increase wiring consistent with the 1300 wire umbilical.	+40.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-56.0
Decrease wiring based on relocating CM to SM umbilical.	-6.0
Add weight reduction contingency.	+5.0
<u>ELECTRICAL POWER</u>	(-9.0)
Increase intermodular plumbing due to adding radiator valves required on the Block II vehicles.	+9.3
Increase wiring, connectors and shape charge consistent with the 1300 wire umbilical.	+39.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-39.3
Increase shape charge based on relocated umbilical requirement.	+20.0
Decrease wiring based on relocating CM to SM umbilical.	-2.0
Decrease cryogenic tanks due to utilizing super insulation.	-31.0
Decrease sequencer based on removing battery and utilizing fuel cell power for pyrotechnics.	-7.0
Decrease oxygen tank support shelf consistent Block II relocated shelf allowance.	-6.0
Add weight reduction contingency.	+8.0

SERVICE MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK IIPROPUSSION

(-175.0)

Decrease propellant and oxidizer tank gauges based on refined tank pressure regulation by utilizing precision valves which allow design for pressure relief at 225 psi rather than 240 psi.	-50.0
Decrease propellant and oxidizer tanks due to shortening the tanks for a 41,000 pound usable propellant.	-189.0
Add isolation valves to the SPS to allow for maintenance with loaded propellant tanks.	+40.0
Increase wiring consistent with the 1300 wire umbilical.	+14.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-18.0
Decrease wiring based on relocating CM to SM umbilical.	-1.0
Add weight reduction contingency.	+29.0

REACTION CONTROL SYSTEM

(+10.0)

Increase reflectors and insulation based on service module boost heating and RCS plume impingement.	+15.0
Increase wiring consistent with the 1300 wire umbilical.	+13.0
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.	-17.0
Reduce attachments for structural closeouts on RCS panels.	-8.0
Decrease wiring based on relocating CM to SM umbilical.	-1.0
Add weight reduction contingency.	+8.0

COMMUNICATIONS & RENDEZVOUS RADAR

(+233.0)

Add high gain antenna system required for deep space communications.	+69.0
Add rendezvous radar equipment consistent with the LOR requirements.	+149.0
Transfer VHF communication antenna from the Command Module.	+29.0
Delete orbital HF antenna required for Block I only	-14.0

TOTAL SERVICE MODULE ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II
(To be brought forward)

+71.0

SERVICE MODULECURRENT ESTIMATED USEFUL LOAD CHANGE TO BLOCK II

<u>MAIN PROPULSION</u>	(+99.0)
Decrease Helium quantity based on reduced propellant.	-12.0
Increase residuals consistent with current propellant requirements.	<u>+111.0</u>
TOTAL SERVICE MODULE ESTIMATED USEFUL LOAD CHANGES TO BLOCK II	+99.0
TOTAL SERVICE MODULE ESTIMATED WEIGHT EMPTY CHANGES TO BLOCK II	<u>+71.0</u>
TOTAL SERVICE MODULE ESTIMATED CHANGES TO BLOCK II	+170.0

LAUNCH ESCAPE SYSTEMCURRENT ESTIMATED WEIGHT CHANGES TO BLOCK IIC/M BOOST PROTECTIVE COVER

(+15.0)

Increase boost cover due to adding provisions to accomplish rapid opening of the main hatch for egress while on the pad.

+15.0

BALLAST

(-135.0)

Decrease ballast consistent with current Command Module LES balance requirements.

-135.0

TOTAL LAUNCH ESCAPE SYSTEM ESTIMATED WEIGHT CHANGES TO BLOCK II

-120.0

ADAPTERCURRENT ESTIMATED WEIGHT CHANGES TO BLOCK II

Decrease S-IV B Adapter utilized on the Block I vehicles due to removing the structure trusses required to stiffen the Adapter when the LEM is not installed.

-75

Add a LEM dispersal system utilizing a dependent type system.

+25

TOTAL ADAPTER CURRENT ESTIMATED WEIGHT CHANGES TO BLOCK II

-50

BLOCK ICOMMAND MODULEPOTENTIAL WEIGHT CHANGESSTABILIZATION & CONTROL

(+5)

Add a manual TVC to the SCS to provide a redundant electrical capability to control the SPS so that a single electrical failure will not prevent a De-Orbit Delta-V maneuver by the SPS, in Block I

+5

CREW SYSTEM

(-69)

Utilize unitized crew couch on Block I per current ground rules for final revision to Block I spec.

-70

Increase flight kits based on lowest vendor estimate.

+2

Decrease portable light based on reduced requirements

-1

ENVIRONMENTAL CONTROL

(+100)

Add a cabin ventilating system per current ground rules for final revision to Block I specification.

+22

Add water for cooling during earth orbit based on the inability of the radiators to supply sufficient cooling due to the indeterminate spacecraft orientation. (2.6 days +78 pounds, 10 day +300 pounds)

+78

EARTH LANDING SYSTEM

(+90)

Add a three bag single point flotation concept per current ground rules for final revision to Block I specification.

+40

Add a sea pick-up to facilitate recovery per NASA DET.

+15

Redesign main parachutes for a higher descending weight.

+35

INSTRUMENTATION

(+5)

Add a display meter and selector switching for intermittent monitoring of measurements formerly accessible via the in-flight test system.

+5

BLOCK ICOMMAND MODULEPOTENTIAL WEIGHT CHANGESREACTION CONTROL

(+20)

Add support provisions for the PCS motor fuel lines per
NASA DET

+20

COMMUNICATIONS

(-7)

Utilize dummy redundant S-Band Transponder in lieu of
active transponder.

-7

CONTROLS & DISPLAYS

(+2)

Add an angle of attack display for launch vehicle EDS.

+2

TOTAL BLOCK I COMMAND MODULE POTENTIAL WEIGHT CHANGES

+146

BLOCK ISERVICE MODULEPOTENTIAL WEIGHT CHANGES

<u>ELECTRICAL POWER</u>	(+2)
Increase fuel cell based on latest vendor status	+2
<u>REACTION CONTROL</u>	(+29)
Increase reflectors and insulation based on Service Module boost heating and RCS plume impingement requiring addition of cork installation.	+15
Add Service Module RCS propellant tankage vents to increase service life of propellant tanks by reducing the cycling of bladder during the fill and drain operation.	+12
Increase RCS engines based on latest vendor status.	+2
<hr/>	
TOTAL BLOCK I SERVICE MODULE POTENTIAL WEIGHT CHANGES	+31

BLOCK ILAUNCH ESCAPE SYSTEMPOTENTIAL WEIGHT CHANGESC/M BOOST PROTECTIVE COVER

(+15)

Increase boost cover due to adding provisions to accomplish rapid opening of the main hatch for egress while on the pad.

+15

TOTAL BLOCK I LAUNCH ESCAPE SYSTEM POTENTIAL WEIGHT CHANGES

+15